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(54) Title: QUARTZ GLASS JIG FOR PROCESSING APPARATUS USING PLASMA

(57) Abstract: An object of the present invention is to provide a quartz glass jig, which, when employed in a processing apparatus using plasma, is less in generation of abnormal etching and particles and low in contamination with impurities. This object is obtained by a quartz glass jig for a processing apparatus using plasma, wherein a surface of the jig is subjected to grinding or a sandblast processing and has a surface roughness R_a in the range of from 2 µm to 0.05 µm, and microcracks of grinding marks formed during the grinding or sandblast processing have a depth of 50 µm or less.

QUARTZ GLASS JIG FOR PROCESSING APPARATUS USING PLASMA

Industrial Field of Application

The present invention relates to a quartz glass jig used in a processing apparatus utilizing plasma, and more specifically, to a quartz glass jig, wherein a surface of the quartz glass jig is roughened by mechanical processing, and the depth of microcracks formed during the mechanical processing is shallow.

Prior Art

Recently, for the surface treatment of a semiconductor device such as a silicon wafer, etc., a treatment method utilizing plasma has become frequently used. As the above-described treatment method utilizing plasma, there are, for example, an etching method of introducing a halogen-based corrosive gas such as a fluorine-based gas, a chlorine-based gas, etc., in a plasma-generating chamber, while introducing a microwave via a microwave-introducing window, thereby forming a plasma from the above-described halogen-based corrosive gas internally present therein and treating a semiconductor device therewith; and a method of depositing silicon dioxide onto a surface of a semiconductor device. In these treatment methods utilizing plasma, as shown in Japanese Patent Laid-Open Nos. 106994/1996 and 339895/1996, etc., processing apparatus are used, and the processing apparatus are equipped with quartz glass-made jigs as window materials, rings for shielding, etc. As the material for the above-described quartz glass-made jigs, a natural quartz glass has hitherto been mainly used, wherein a surface thereof, which is brought into contact with plasma, is roughened by mechanical processing, thereby designing to stabilize the etching speed and to prevent attached materials from separation. For the mechanical processing, there have been used grinding processing using a whetstone such as diamond, etc., a sandblast processing method using a powder such as a silicon dioxide

Also, another object of the invention is to provide a quarts glass jig made of a synthetic quartz glass, which is more excellent in the characteristics described above.

Means for Solving the Problems

In order to attain the above-described objects, a invention is concerned with a quartz jig glass for a processing apparatus using plasma, wherein a surface of the jig is subjected to mechanical processing such that the quartz glass jig has a surface roughness R_a in the range of from 2 µm to 0.05 µm, and microcracks formed during the mechanical processing have a depth of 50 µm or less. The mechanical processing can be a grinding or a sandblast processing alternatively. Microcracks of grinding marks formed during the grinding processing have a depth of 50 µm or less; and microcracks formed during the sandblast processing have a depth of 50 µm or less.

The quartz glass jig of the invention is a jig prepared from a natural or synthetic quartz glass, wherein its inner surface, which is brought into contact with plasma, is roughened such that a surface roughness R_a *is in the range of from 2 µm to 0.05 µm*, for stabilizing the etching speed or preventing attached materials from separation. When the surface roughness R_a exceeds 2 µm, radicals or ions generated within the plasma attack locally recesses on the roughened surface, whereby abnormal etching progresses. On the other hand, when the Ra is less than 0.05 µm, secondary products (for example, particles, etc.) formed by the plasma are liable to be separated from the surface, so that the characteristics of the semiconductor device are possibly deteriorated.

The above-described roughened surface is formed by a method of scraping away the quartz glass surface by a mechanical processing method such as grinding processing using a whetstone such as diamond abrasive grains, sandblast processing using a powder such as a silicon dioxide powder, a ceramics powder, etc., but in this case, microcracks are formed on the surface. It is important that the depth of the microcracks formed is 50 µm or less. When the depth of the microcracks exceeds 50 µm, the particles of the quartz glass are liable to be separated from the quartz glass surface, and particles are more likely generated during the plasma treatment, thereby markedly hindering the electric characteristics of the semiconductor. In the grinding

or to widen the microcracks with hydrofluoric acid after the angle polishing.

As a material for preparing the quartz glass jig of the invention, is desired a synthetic quartz glass, which has a low content of air bubbles and is excellent in homogeneity. The air bubbles become a precursor for abnormal holes to radicals or ions within the plasma, so that etching proceeds faster to form large holes. Also, when the homogeneity is low, the etching treatment is not uniformly carried out, and abnormal etching occurs.

Mode for Carrying out the Invention

Next, the invention will be explained in detail by the practical examples, but these examples are illustratively shown, and the invention is not limited thereto.

Examples

Example 1

A surface of a quartz glass was processed with a whetstone made of diamond having a particle size of 100 μm to obtain a quartz glass-made ring for shielding having a surface roughness R_a of 1 μm. When the surface of this ring for shielding was observed by a microscope, 20 per millimeter of grinding marks were confirmed as shown in Fig. 1. Incidentally, Fig. 1 is a microscopic photograph of 100 magnifications of the surface of the ring for shielding described above, wherein (a) is an inner periphery side, (b) is a central portion, and (c) is an outer periphery side. With respect to a sample subjected to the same processing, after rinsing with 15% HF for 30 minutes, the sample was attached to a tip portion of a piston of a polishing apparatus shown in Fig. 2, the surface of the sample was inclined by 5° and polished to expose a microcrack layer 5 as shown in Fig. 3. A microscopic photograph at this time is shown in Fig. 4. In Fig. 4, at the right side a white portion is the portion subjected to angle polishing, and the left is a surface not subjected to angle polishing of the glass. In the portion subjected to angle polishing (transparent portion), whisker-like streaks are present, which are the microcracks widened with hydrofluoric acid. Such microcracks in the depth direction can be easily observed from the above. The length L of the whisker-like streaks was obtained from an interface between the transparent portion and a surface portion (the portion where the whiskers are gathered), and a depth (D)

processing is 50 μm or less. When it is used as a jig for a plasma processing apparatus, abnormal etching and particles are not generated, semiconductor devices are not contaminated with impurities, and high-quality semiconductor devices can be produced at a low cost.

Brief Description of the Drawings

Fig. 1 A microscopic photograph of the surface of the quartz glass jig of Example 1, wherein (a) shows an inner periphery side of the jig, (b) shows a central portion of the jig, and (c) shows an outer periphery side of the jig.

Fig. 2 A schematic diagram of the principal portion of the polishing apparatus for use in the angle polishing process.

Fig. 3 An enlarged cross-section of a specimen polished with a polishing apparatus shown in Fig. 2.

Fig. 4 A microscopic photograph showing a specimen with streaky microcracks after angle polishing treatment, wherein the white or grey portion is a portion not subjected to angle polishing, and the black streaky portion is a portion subjected to angle polishing.

Description of the Reference Numerals and Signs

1:	Cylinder
2:	Piston
3:	Polishing material
4:	Specimen
5:	Microcrack layer
θ:	Polishing angle
L:	Polished length

Fig. 1

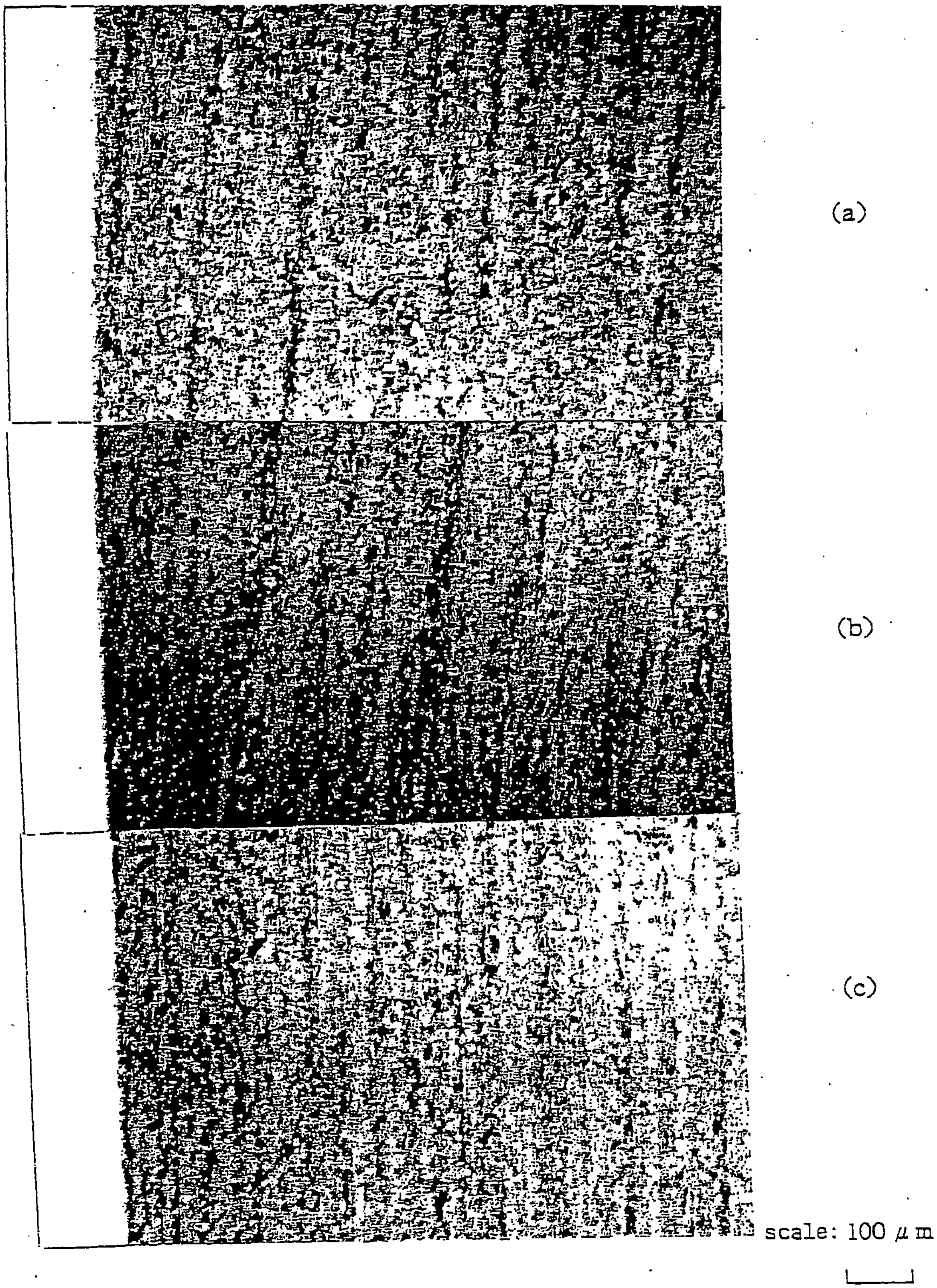


Fig. 2

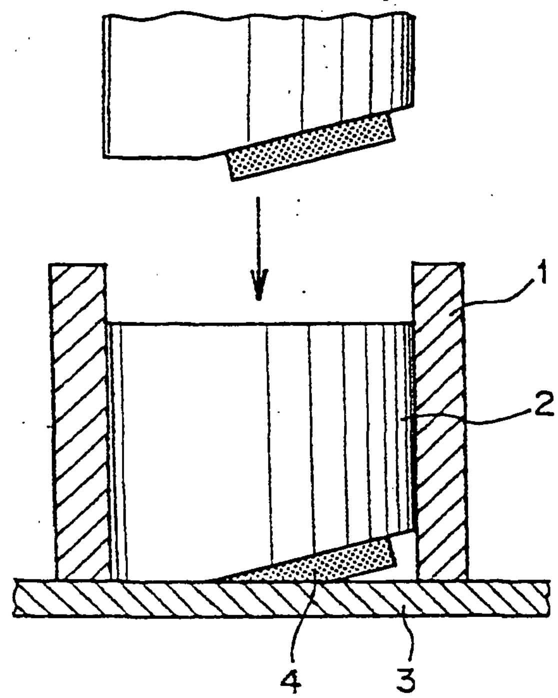


Fig. 3

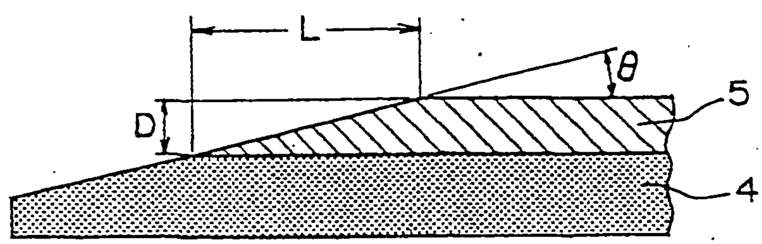
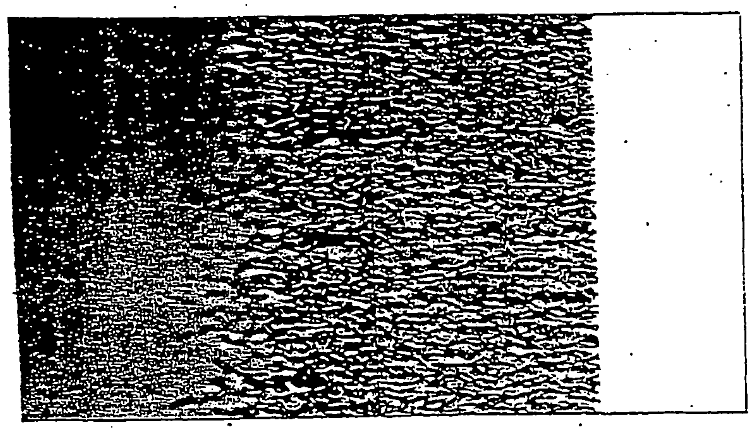


Fig. 4



scale: 100 μm